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(54) Titre : ALLIAGE DENTAIRE A FORTE TENEUR EN OR
(54) Title: DENTAL ALLOY OF HIGH GOLD CONTENT

(57) Abrégé/Abstract:
The new dental alloy of high gold content which is particularly suited for facing with ceramic consists of from 91 to 99.4 % of gold, from 0.5 to 3 % of titanium and/or tantalum, from 0 to 5 % of silver and from 0 to 1 % of at least one of iridium, rhodium, ruthenium, platinum, palladium, osmium, tungsten, iron, molybdenum, niobium and rhenium, the percentages indicated being by weight. This dental alloy is extremely biologically compatible and can be used in the conventional technique and in the burning-on technique as well so that it may be employed as a universal gold alloy which fulfils the standards ISO 1562 and ISO 9693 and, respectively, DIN 13927.

Abstract of the Disclosure

The new dental alloy of high gold content which is particularly suited for facing with ceramic consists of from 91 to 99.4 % of gold, from 0.5 to 3 % of titanium and/or tantalum, from 0 to 5 % of silver and from 0 to 1 % of at least one of iridium, rhodium, ruthenium, platinum, palladium, osmium, tungsten, iron, molybdenum, niobium and rhenium, the percentages indicated being by weight.

This dental alloy is extremely biologically compatible and can be used in the conventional technique and in the burning-on technique as well so that it may be employed as a universal gold alloy which fulfils the standards ISO 1562 and ISO 9693 and, respectively, DIN 13927.

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Dental alloy of high gold content

Background of the Invention

The present invention belongs to the field of dental art and is related to a new and useful dental alloy having a high gold content and a golden yellow colour, and which is destined and appropriate for the facing with commercially available dental ceramic compounds and for the manufacture of dental prosthesis parts as well which remain unfaced or are to be faced with synthetic or other materials.

Noble metal dental alloys having a high gold content are widely spread for the use in metallic, solidly fastened dentures such as crowns, bridges etc., inter alia because of their good biological compatibility and high corrosion resistance in the mouth milieu. Furthermore, they are technically easy to process.

Silver and copper containing gold casting alloys are successfully used since a long time in restorative dentistry. In the conventional alloys, the high mechanical resistance required for these materials when unfaced parts or parts to be faced with synthetic materials are to be made, is adjusted through the silver to copper ratio.

In view of optimal aesthetics of solidly fastened dental reconstructions, especially in the visible region, an at least partial facing of a metallic base by a ceramic compound has proven to be particularly appropriate since the advantages of the ceramics, namely hardness, aesthetics and outstanding biological compa-

tibility, can optimally be combined in this material composite with the advantages of the metallic material, namely tensile strength and better precision of fit.

The use of a ceramic facing requires special properties of the alloy. Thus, the melting interval of the alloy should markedly be higher than the baking temperature of the ceramics which is about 980 °C, and the alloy must furthermore present a sufficient burning stability so that the metallic base to be faced remains dimensionally stable during the burning or baking operation.

In order to guarantee a durable adhesion between alloy and ceramics, no tensile stress should build up during the manufacture process. This is achieved, in an already known manner, by selecting the thermal expansion coefficient of the alloy slightly higher than that of the ceramics. During the cooling process, a compressive strain is produced in the ceramic coating due to the somewhat higher shrinking alloy.

The requirements cited above have resulted in the development of special alloys called burn-on alloys which form an own class besides the conventional gold casting alloys and which are standardized by the standards ISO 9693 and DIN 13927.

In order to achieve the above discussed required properties of burn-on alloys, the elements platinum and/or palladium have been added by alloying to the alloys for metal-ceramic on the base of gold. Furthermore, other metals than noble ones are added by

alloying in order to improve the strength of the alloy, such as copper, indium, gallium, tin and/or zinc. The alloy strength could basically be improved by adding higher proportions of silver and copper; however, this possibility cannot be used because of undesired reactions of such alloys with the ceramic and of a too high oxidation of the alloy.

In particular, additions of palladium, but also of platinum lead to a sensible reduction of the desired yellow colour of the alloy which is felt by the patient as aesthetically agreeable and desirable.

Recently, some non-noble metals used in the noble metal alloys have been suspected to cause troubles and pathological reactions in some patients. Reference is especially made to indium which is contained in nearly all burn-on alloys; see the article of J. Wirz: "Schädigung des Paradontes durch zahnärztliche Werkstoffe" (Damage of the paradontium by dentistry materials), Zahnärztliche Welt 102, 146 (1993). Palladium too is suspected to provoke toxic or allergic reactions if it is contained in higher proportions in the noble metal alloy and is therefore able to be liberated by corrosion. Furthermore, the need for a universally applicable dental alloy becomes more and more relevant, i.e. an alloy which is suitable both for conventional dental prostheses which remain unfaced or are faced with synthetic material, respectively, and for the technique of metal-ceramic. Such alloys have the advantage of excluding the danger of forming a galvanic element due to the use of different alloys in the mouth cavity, accompanied by corrosion processes. Recently, such universal alloys are promoted which, however, are

on the base of Au-Ag-Pt-Cu with the addition of the non-noble metals indium and zinc. These alloys present the shortcomings that they are relatively susceptible to corrosion, in particular due to the surface oxides formed during burning which are not necessarily covered by ceramic in the region of the crown edges and are therefore accessible to saliva and its corrosive action. Furthermore, a special, low melting ceramic is required for this alloy and which, dependent on the manufacturing method, presents a higher corrosion rate than the known higher melting facing ceramics.

In addition, alloys of high gold content generally present a bad high temperature creeping resistance so that metallic, long span bridge structures are generally deformed during the burning process and loose their fitting precision. Therefore, long bridges that are to be faced with ceramic must be made from alloys having a higher palladium content, but they do no longer have the desired old gold colour appreciated by the patient, and they present the biological drawbacks mentioned above.

On the other hand, the non-noble metals titanium and tantalum have proven to be strongly biologically compatible materials in dentistry. For example, implants of titanium will heal in the bone without any defense reaction due to the superficial formation of titanium oxide which is very corrosion resistant and inert, and allergic reactions on this material are occurring extremely seldom, if at all. Therefore, these metals are to be considered from a clinical and

biological sight as ideal alloy partners for gold which is known to be extremely corrosion stable too.

Titanium containing dental alloys of high gold content which are suited for the facing with ceramics have already become known from the patent literature. DE-A-2,302,837 discloses a titanium alloy of high gold content which further contains a relative high proportion of platinum or a metal of the platinum group as well as palladium which may provoke, as already described above, allergic reactions. Furthermore, the succeeding application published under DE-A-2,357,552 describes a titanium alloy of high gold content which also contains an element of the platinum group, but no quantitative indications can be found.

In addition, titanium alloys of high gold content for the use in jewelry have become known, for example from EP-A-0,190,648. These ornamental alloys must respond to other criteria than those of dental alloys, and compositions of ornamental alloys that are disclosed cannot be transferred automatically, see above, to dental alloys.

Summary of the Invention

Based upon this prior art, it is a first and major object of the present invention to provide new and useful dental alloys which not only present an outstanding biological compatibility but also can be used in a universal manner.

There is another object of the invention to provide dental alloys which fulfil the standards ISO 1562 and ISO 9693 as well as DIN 13927.

A further object of the invention is to provide dental alloys having a high gold content which present, in spite of other metals alloyed thereto, the pleasant and most desired yellow colour of genuine gold.

All these objects are attained by the high gold content dental alloys of the invention which comprise, on a weight basis, 91 to 99.4 % of gold, 0.5 to 3 % of at least one metal selected from titanium and tantalum, 0 to 5 % of silver, and 0 to 1 % of at least one element selected from the group comprising iridium, rhodium, ruthenium, platinum, osmium, tungsten, iron, molybdenum, niobium and rhenium.

An alloy which is particularly suited for the intended purposes of this invention comprises 97.5 to 98.5 % of gold, 1.4 to 2.4 % of titanium and 0.05 to 0.15 % of iridium.

Detailed Description of the Invention

Tests have shown that an alloy composed of 91 to 99.4 % of gold, 0.5 to 3 % of titanium and/or tantalum, 0 to 5 % of silver and 0 to 1 % of iridium, rhodium, ruthenium, platinum, palladium, osmium, tungsten, iron, molybdenum, niobium and/or rhenium, surprisingly presents universal properties and can therefore also be used in conventional techniques; the alloy fulfils the requirements of the standards ISO 1652

and ISO 9693 and of DIN 13927 as well. Since gold as well as titanium are extremely biologically compatible, an alloy of these two components is extremely biologically compatible too and is furthermore very attractive from an aesthetical viewpoint since the titanium or the tantalum, respectively, do not sensibly influence the golden colour. Furthermore, this alloy only contains a very small proportion of non-noble metals so that it does not loose its corrosion stability.

Furthermore, it has surprisingly been found that alloys having the mentioned composition display a very good high temperature creeping stability. For example, an alloy having the following composition: 97.5 to 98.5 % of gold, 1.4 to 2.4 % of titanium, and 0.05 to 0.15 % of iridium has a high temperature creeping stability better than all of the noble metal casting alloys used so far in the dental field. For the first time, this alloys allow without problems to face long metallic bridge structures, produced by casting from a golden yellow alloy of a high gold content, with ceramics. It could be shown that on the addition of more than 1 % of platinum to this alloy, as it has for example been described in DE-A-2,302,837, the high temperature creeping resistance is markedly reduced.

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Claims

1. A dental alloy of high gold content, characterized that it consists of from 91 to 99.4 % of gold, from 0.5 to 3 % of at least one metal selected from titanium and tantalum, from 0 to 5 % of silver, from 0 to 1 % of at least one metal selected from iridium, rhodium, ruthenium, platinum, palladium, osmium, tungsten, iron, molybdenum, niobium and rhenium, the percentages given being by weight.

2. The dental alloy of high gold content according to claim 1, characterized in that it consists of from 97.5 to 98.5 % of gold, from 1.4 to 2.4 % of titanium, and from 0.05 to 0.15 % of iridium.